

REMARKS

The Office Action mailed May 18, 2006, has been received and reviewed. Claims 1 through 59 are currently pending in the application. Claims 1 through 59 stand rejected. Applicants have amended claims 1, 8, 16, 30, 32, 39, 49, and 59, cancelled claims 4, 7, 19, 22, 35, 38, and 54, and respectfully request reconsideration of the application as presented herein.

Claim Objections

Claim 1 is objected to due to informalities in the claim language. Applicants have deleted the language in claim 1 objected to by the Examiner.

35 U.S.C. § 102(b) Anticipation Rejections

Anticipation Rejection Based on U.S. Patent No. 6,610,780 to Payzant et al.

Claims 1 through 3 and 7 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Payzant et al. (U.S. Patent No. 6,610,780). Applicants have cancelled claim 7. Applicants respectfully traverse this rejection with respect to claims 1 through 3, as hereinafter set forth.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Applicants respectfully assert that independent claim 1 is not anticipated by Payzant et al. under 35 U.S.C. § 102(e) because Payzant et al. does not describe each and every element of independent claim 1, as currently amended. In particular, Payzant et al. does not describe an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in independent claim 1.

Payzant et al. describes a networked polymer/clay alloy (NPC Alloy) that includes clay particles that form a unique chemical association (e.g., hydrogen bonding, ionic bonding, or Van der Waal's bonding) with a networked polymer as it is formed. *Payzant et al.*, column 5, lines

14-21. The NPC Alloys described by Payzant et al. are formed by preparing a mixture comprising a monomer, clay particles, a cross-linking agent, and a mixing fluid (*Id.*, column 6, lines 17-19), and polymerizing and cross-linking the monomers in the mixture (*Id.*, column 8, lines 54-57). Payzant et al. further describes that metal complexing agents may be added to the mixture to sequester metal ions that might otherwise interfere with forming the NPC alloys. *Id.*, column 8, lines 6-20.

Payzant et al. does not, however, characterize any of the NPC alloys described therein as a *nanocomposite* material, as recited in claim 1. In the Background Discussion Section of Payzant et al., Payzant et al. states that “monomers may be intercalated in...swelling clays and polymerized into a nanocomposite.” *Payzant et al.*, column 2, lines 16-18. Payzant et al. does not describe, teach, or suggest that the NPC Alloys described in the Detailed Description of Preferred Embodiments Section thereof are nanocomposite materials. While Applicants admit that Payzant et al. describes the mixing solution as being substantially homogenous, Applicants respectfully assert that it does not inherently follow that the NPC alloys formed therefrom are also substantially homogenous, as phase separation may occur as the monomers begin to polymerize and cross-link with one another. Furthermore, Payzant et al. also does not describe the clays and polymers of the NPC alloys as forming an *interpenetrating network*, as also recited in claim 1.

As Payzant et al. does not describe each and every element of independent claim 1, Applicants assert that claim 1 is not anticipated by Payzant et al. and respectfully request that the Examiner withdraw the rejection of independent claim 1 under 35 U.S.C. § 102(e).

Applicants additionally assert that dependent claims 2 and 3 are allowable at least because each depends from claim 1, which is allowable. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 2 and 3 under 35 U.S.C. § 102(e).

35 U.S.C. § 103(a) Obviousness RejectionsObviousness Rejection Based on U.S. Patent No. 4,636,314 to Beuhler et al.

Claims 1 through 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Beuhler et al. (U.S. Patent No. 4,636,314). Applicants have cancelled claims 4 and 7.

Applicants respectfully traverse this rejection with respect to claims 1 through 3, 5, 6, and 8, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Applicants respectfully assert that claims 1 through 3, 5, 6, and 8 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Beuhler et al. because Beuhler et al. does not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in independent claim 1 as currently amended.

Beuhler et al. teaches a material that includes an inorganic oxide constituent (alumina), a hydrophilic polymer constituent (poly(vinyl alcohol)), and a metal ion sequestration constituent (ammonium molybdophosphate (AMP)). *Beuhler et al.*, column 3, line 58 – column 4, line 30. Beuhler et al. does not teach or suggest, however, that the poly(vinyl alcohol) and the alumina form an interpenetrating network, or that the (AMP) is substantially uniformly distributed through such an interpenetrating network. In contrast, Beuhler et al. teaches a thin film membrane that includes a two components, one component being a single phase blend of a polymer (e.g., poly(vinyl alcohol) and a heteropoly acid or salt thereof (e.g., AMP) and the other

component being or including electrically conductive particles. *Beuhler et al.*, column 3, line 58 – column 4, line 30; *see also* claim 1. *Beuhler et al.* does not teach or suggest that the alumina forms an *interpenetrating network* with the polymer constituent, or that the alumina and polymer constituent, together with the AMP, are part of a substantially homogenous nanocomposite material.

As *Beuhler et al.* does not teach or suggest all the limitations recited in independent claim 1, as currently amended, Applicants respectfully assert that independent claim 1 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering *Beuhler et al.*, and request that the Examiner withdraw the rejection of independent claim 1 under 35 U.S.C. § 103(a).

Furthermore, the nonobviousness of independent claim 1 precludes a rejection of claims 2, 3, 5, 6, and 8, which depend therefrom, because a dependent claim is obvious only if the independent claim from which it depends is obvious. *See In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988), *see also* MPEP § 2143.03. Therefore, Applicants request that the Examiner withdraw the 35 U.S.C. § 103(a) obviousness rejection to claims 2, 3, 5, 6, and 8, in addition to the rejection to independent claim 1.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials”

Claims 1 through 3, 5, 7, 16 through 18, 20, 22, 31 through 34, 36, 38, 49, 52, 53, 55, 57, and 58 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials.” Applicants have cancelled claims 7, 22, and 38, and respectfully traverse this rejection with respect to the remaining rejected claims, as hereinafter set forth.

Applicants respectfully assert that claims 1 through 3, 5, 16 through 18, 20, 31 through 34, 36, 49, 52, 53, 55, 57 and 58 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. because Polson et al. does not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly

distributed therethrough, as recited in each of independent claims 1, 16, 32, and 49, as currently amended.

Polson et al. teaches “nanocomposites, which combine polymers with ceramics” for use in “subsurface remediation efforts” “through the formation of an *in-situ* permeable reactive barrier (PRB).” The permeable reactive barrier allows for “selective mass transport through the barrier wall to control environmental contaminants.” “The ceramic component of the composite transforms a water-soluble organic polymer into a new material with the same properties as a hydrogel.” “The concept allows water and other benign species to flow through the PRB, while blocking the flow of contaminants of concern.” Polson et al. also mentions the incorporation of “selective cesium capturing agents, such as aminomolybdophosphate (AMP).”

Polson et al. does not teach or suggest that the nanocomposites are substantially homogenous, that the ceramics and polymers form interpenetrating networks, that the polymers are selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, or that the AMP is substantially uniformly distributed through an interpenetrating network, as recited in independent claims 1, 16, 32, and 49.

As Polson et al. does not teach or suggest each of the limitations recited in each of independent claims 1, 16, 32, and 49, Applicants respectfully assert that each of independent claims 1, 16, 32, and 49 could not have been obvious to a person of ordinary skill in the art at the time each invention was made considering Polson et al., and request that the Examiner withdraw the rejection of independent claims 1, 16, 32, and 49 under 35 U.S.C. § 103(a).

Furthermore, the nonobviousness of independent claims 1, 16, 32, and 49 precludes a rejection of claims 2 through 3, 5, 17 through 18, 20, 31, 33 through 34, 36, 52, 53, 55, 57 and 58, each of which depends from one of independent claims 1, 16, 32, and 49, because a dependent claim is obvious only if the independent claim from which it depends is obvious. *See In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988), *see also* MPEP § 2143.03. Therefore, Applicants request that the Examiner withdraw the 35 U.S.C. § 103(a) obviousness rejection to dependent claims 2 through 3, 5, 17 through 18, 20, 31, 33 through 34, 36, 52, 53, 55, 57 and 58 at least for this reason, in addition to the rejection to independent claims 1, 16, 32, and 49.

Regarding dependent claims 2, 17, 33, and 52, Applicants additionally assert that Polson et al. does not teach or suggest that the ceramics include a metal oxide, as recited in dependent

claims 2, 17, 33, and 52. Therefore, Applicants respectfully assert that dependent claims 2, 17, 33, and 52 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al., and request that the Examiner withdraw the rejection of these dependent claims under 35 U.S.C. § 103(a) for this additional reason.

Regarding dependent claims 3, 18, 34, and 53, Applicants additionally assert that Polson et al. does not teach or suggest that the ceramics include a constituent selected from silicon dioxide, aluminum oxide, titanium oxide, zirconium oxide, boron oxide, and combinations thereof, as recited in dependent claims 3, 18, 34, and 53. Therefore, Applicants respectfully assert that dependent claims 3, 18, 34, and 53 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al., and request that the Examiner withdraw the rejection of these dependent claims under 35 U.S.C. § 103(a) for this additional reason.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of U.S. Publication No. 2002/0121470 to Mann et al. or Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties”

Claims 4, 6, 8, 19, 21, 30, 35, 37, 39, 54, 56, and 59 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Mann et al. (U.S. Publication No. 2002/0121470) or Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties.” Applicants have cancelled claims 4, 19, 35, and 54, and respectfully traverse this rejection with respect to the remaining rejected claims, as hereinafter set forth.

Each of dependent claims 6, 8, 21, 30, 37, 39, 56 and 59 depends from one of independent claims 1, 16, 32, and 49.

Applicants respectfully assert that claims 6, 8, 21, 30, 37, 39, 56 and 59 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Mann et al. or Sebesta et al. because the references relied

upon by the Examiner, when combined, do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in each of independent claims 1, 16, 32, and 49, as currently amended. As discussed above, Polson et al. does not teach or suggest these limitations. Combining the teachings of Mann et al. or Sebesta et al. with the teachings of Polson et al. does not satisfy the deficiency.

Mann et al. teaches beads 302 of a composite medium 300 that includes a matrix material 303 that defines a plurality of pores 302A, in which active components 304 can be distributed. *Mann et al.*, paragraph [0051]. Mann et al. further teaches that the matrix material 303 may comprise polyacrylonitrile (PAN) and the active component 304 may comprise ammonium molybdophosphate (AMP) (*Id.*, Paragraph [0059]), and that an ion processing system may be used in conjunction with the processing of a fluid stream containing cesium (*Id.*, Paragraph [0041]).

Mann et al. does not teach or suggest that the beads 302 may include an interpenetrating network formed by the PAN and an inorganic constituent, or that the AMP may be substantially uniformly distributed through such an interpenetrating network.

Sebesta et al. describes a composite ion exchanger that includes an organic binding polymer based on polyacrylonitrile (PAN) and ammonium molybdophosphate (AMP) as an active component for adsorption of cesium. Sebesta et al. suggests using such composite ion exchanges for purification of liquid wastes discharged into the environment.

Sebesta et al. does not, however, teach or suggest an interpenetrating network formed by the PAN and an inorganic constituent, or that the AMP may be substantially uniformly distributed through such an interpenetrating network.

As Polson et al., considered in view of either Mann et al. or Sebesta et al., does not teach or suggest all the limitations of any of independent claims 1, 16, 32, and 49, Applicants respectfully assert that dependent claims 6, 8, 21, 30, 37, 39, 56 and 59 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the references relied upon by the Examiner, and request that the Examiner withdraw the rejection of these dependent claims under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of EPA/600/R-98/125 “Permeable Reactive Barrier Technologies for Contaminant Remediation”

Claims 24 through 28, 44 through 48, and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of EPA/600/R-98/125 (referred to hereinafter as “EPA”), which is entitled “Permeable Reactive Barrier Technologies for Contaminant Remediation.” Applicants respectfully traverse this rejection, as hereinafter set forth.

Each of claims 24 through 28 depends from claim 16, each of claims 44 through 48 depends from claim 32, and claim 51 depends from claim 49.

Applicants respectfully assert that claims 24 through 28, 44 through 48, and 51 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of EPA because the references relied upon by the Examiner, when combined, do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in each of independent claims 1, 16, 32, and 49, as currently amended. As discussed above, Polson et al. does not teach or suggest these limitations. Combining the teachings of EPA with the teachings of Polson et al. does not satisfy the deficiency.

EPA describes the use of permeable reactive barriers for treating contaminated water. EPA teaches providing a membrane in an excavated trench within a portion of the water table in the ground. *See EPA*, pages 28-29. EPA further describes substantially impermeable walls positioned and located within the ground to direct flow of groundwater toward the membrane. The walls are disposed at an angle greater than zero degrees in relation to the membrane, and suggest that the walls may be disposed in a portion of the water table. *See EPA*, FIG. 1 at page 1, and FIG. 8b at page 28. EPA does not, however, teach or suggest an interpenetrating network

formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof. Furthermore, EPA does not teach or suggest an interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough.

As Polson et al. and EPA, when combined, do not teach or suggest all the limitations of any of independent claims 16, 32, and 49, Applicants respectfully assert that dependent claims 24 through 28, 44 through 48, and 51 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the references relied upon by the Examiner, and request that the Examiner withdraw the rejection of these dependent claims under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of U.S. Publication No. 2001/0033772 to Gilmore et al.

Claims 23, 40, and 50 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Gilmore et al. (U.S. Publication No. 2001/0033772). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 23 depends directly from claim 16 and includes the elements and limitations recited therein, claim 40 depends directly from claim 32 and includes the elements and limitations recited therein, and claim 50 depends directly from claim 49 and includes the elements and limitations recited therein.

Applicants respectfully assert that claims 23, 40, and 50 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references because, when combined, the references relied upon by the Examiner do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network

having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in each of independent claims 16, 32, and 49, as currently amended. As discussed above, Polson et al. does not teach or suggest these limitations. Combining the teachings of Gilmore et al. with the teachings of Polson et al. does not satisfy the deficiency.

Gilmore et al. describes forming a reactive barrier in a vadose region of the ground. The reactive barrier is formed by modifying the soil or its properties. *Gilmore et al.*, page 2, paragraphs [0019], [0023]; Figure 1. Gilmore et al. does not, however, teach or suggest an interpenetrating network formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof. Furthermore, Gilmore et al. does not teach or suggest an interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough.

As Polson et al. and Gilmore et al., when combined, do not teach or suggest each of the limitations of any one of dependent claims 23, 40, and 50, these claims could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. and Gilmore et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 23, 40, and 50 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of U.S. Patent No. 5,857,810 to Cantrell et al.

Claim 29 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Cantrell et al. (U.S. Patent No. 5,857,810). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 29 depends directly from claim 16 and includes the elements and limitations recited therein.

Applicants respectfully assert that claim 29 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art

references because, when combined, the cited prior art references do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in each of independent claims 16, 32, and 49, as currently amended. As discussed above, Polson et al. does not teach or suggest these limitations. Combining the teachings of Cantrell et al. with the teachings of Polson et al. does not satisfy the deficiency.

Cantrell et al. describes a chemical barrier that includes a colloid suspension that is injected into the subsurface. *Cantrell et al.*, column 2, lines 11-12. Cantrell further discloses that it is preferred that the hydraulic conductivity of the colloid suspension with respect to the subsurface be the same as that observed for water. *Cantrell et al.*, column 4, lines 36-41.

Cantrell et al. does not, however, teach or suggest an interpenetrating network formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof. Furthermore, EPA does not teach or suggest an interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough. Furthermore, Cantrell et al. does not teach or suggest a permeable reactive barrier having a membrane that “exhibits a permeability substantially the same as a hydraulic conductivity of the ground the membrane is placed within,” as recited in dependent claim 29.

As Polson et al. and Cantrell et al., when combined, do not teach or suggest each of the limitations of dependent claim 29, claim 29 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claim 29 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of U.S. Patent No. 5,728,302 to Conner et al.

Claims 42 and 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Conner et al. (U.S. Patent No. 5,728,302). Applicants respectfully traverse this rejection, as hereinafter set forth.

Each of claims 42 and 43 depends either directly or indirectly from claim 32 and, as a result, each includes the elements and limitations recited in independent claim 32.

Applicants respectfully assert that claims 42 and 43 could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering the references relied upon by the Examiner because, when combined, the references do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in independent claim 32 as currently amended. As discussed above, Polson et al. does not teach or suggest these limitations. Combining the teachings of Conner et al. with the teachings of Polson et al. does not satisfy the deficiency.

Conner et al. describes introducing an ion exchange resin into a reservoir matrix to act as an “in-situ filter for dissolved radionuclides presenting the reservoir (or aquifer) fluids. *Conner et al.*, column 3, lines 20-25. The fine resin “is directly introduced into the reservoir as a solid phase component of a solid-liquid slurry using high-pressure injection techniques. *Conner et al.*, column 3, lines 25-27.

Conner et al. does not, however, teach or suggest an interpenetrating network formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof. Furthermore, EPA does not teach or suggest an interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough.

As Polson et al. and Conner et al., when combined, do not teach or suggest each of the limitations recited in any one of dependent claims 42 and 43, these claims could not have been obvious to a person of ordinary skill in the art at the time the inventions were made considering

Polson et al. and Conner et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 42 and 43 under 35 U.S.C. § 103(a).

Regarding dependent claim 42, Applicants additionally assert that none of the prior art references teach or suggest forming a membrane by “injecting a slurry into the ground, the slurry comprising a plurality of discrete particles of [a] nanocomposite material dispersed in a liquid,” as recited in dependent claim 42 as currently amended. Therefore, Applicants respectfully assert that dependent claim 42 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the cited prior art references, and request that the Examiner withdraw the rejection of dependent claim 42 under 35 U.S.C. § 103(a) for this additional reason.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers”

Claims 9 through 11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” as applied to claims 1-3, 5, 7, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers.” Applicants respectfully traverse this rejection, as hereinafter set forth.

Applicants respectfully assert that claims 9 through 11 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al. because there is no motivation to combine the teachings of Novak et al. with the teachings of Polson et al. In particular, Applicants respectfully assert that there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the teachings of Novak et al. to provide a *solvated hydrophilic polymer*, as recited therein. The Examiner asserted at Page 5 of the Office Action mailed November 28, 2005, that “Novak discloses dissolving ... polymers to form interpenetrating networks.” Applicants respectfully disagree and assert that Novak et al. describes interpenetrating networks, but *does not describe dissolving polymers* to form such

interpenetrating networks. Furthermore, Novak et al. *teaches away* from providing a *solvated hydrophilic polymer*. As discussed in a previously submitted response, Novak et al. states (beginning at the fourth line of the third full paragraph of the first column on the first page (698))

“[w]e, as well as others, have been interested in forming semi-interpenetrating networks fashioned by dissolving preformed polymers in the sol-gel solutions, and allowing the SiO₂ network to form around the polymer domains. In an effort to provide better phase homogeneity, between the two chemically dissimilar phases and to increase the mechanical strength of these interesting composite materials, we began investigations into the formation of simultaneous interpenetrating networks (SIPN's) by the **synchronous formation** of both a cross-linked inorganic glass and a cross-linked organic polymer.” (emphasis added)

Novak et al. then describes in detail two mechanisms for simultaneously polymerizing a polymer material and forming a cross-linked inorganic glass. In other words, Novak et al. suggests that composite materials made by dissolving polymers in a solvent exhibit inferior homogeneity and mechanical strength, and that composite materials made instead by simultaneous, synchronous formation of a polymer material from polymer precursor materials and formation of a cross-linked inorganic glass are superior and preferable.

The Examiner has asserted at Page 13 in the outstanding Office Action that “Novak does not teach away from using solvated polymer. In the ninth full paragraph, Novak discloses using ‘a stoichiometric amount of water and corresponding polymerizable alcohol as the cosolvent.’” Applicants respectfully assert that polymerizable alcohol is not a polymer until it has been polymerized.

Therefore, Novak et al. clearly teaches away from providing a solvated hydrophilic polymer, as recited in independent claim 9.

It also follows, that Novak et al. does not teach or suggest providing a mixture of a solvated hydrophilic **polymer** and an inorganic **precursor**, as recited in independent claim 9. In contrast, Novak et al. teaches providing a mixture of a polymer **precursor** (i.e., polymerizable alcohol) and an inorganic **precursor**.

Applicants additionally assert that Polson et al. and Novak et al., when combined, do not teach or suggest “tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,” as also recited in independent claim 9. Although Polson et al. discloses deliberately altering a physical stabilization of a nanocomposite material to adjust the properties of the composite to

those required for subsurface applications, this broad statement in no way teaches or suggests the limitation of tailoring the concentration of a hydrophilic polymer in a mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture.

For each of the above reasons, Applicants respectfully assert that independent claim 9 could not have been obvious to one of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al., and request that the Examiner withdraw the rejection of independent claim 9 under 35 U.S.C. § 103(a).

Furthermore, the nonobviousness of independent claim 9 precludes a rejection of claims 10 and 11, which depend therefrom, because a dependent claim is obvious only if the independent claim from which it depends is obvious. *See In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988), *see also* MPEP § 2143.03. Therefore, Applicants request that the Examiner withdraw the 35 U.S.C. § 103(a) obviousness rejection to claims 10 and 11, in addition to the rejection to independent claim 9.

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-11, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach”

Claim 12 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-11, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach.” Applicants respectfully traverse this rejection, as hereinafter set forth. Claim 12 depends indirectly from claim 9, and, as a result, includes the elements and limitations recited in independent claim 9.

Applicants respectfully assert that claim 12 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the references relied upon by the Examiner because there is no motivation to combine the teachings of Novak et al. with the teachings of Polson et al., as discussed above in relation to claim 9.

Furthermore, the references relied upon by the Examiner do not teach or suggest “tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9.

As previously discussed herein, Polson et al. and Novak et al., when combined, do not teach or suggest “tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,” as recited in independent claim 9. The teachings of Wen et al. do not satisfy the deficiency.

Wen et al. summarize the then-current state of the art of organic/inorganic hybrid network materials formed by the sol-gel technique. Wen et al. teach that tetraethoxysilane may be used as an inorganic precursor for forming an organic/inorganic hybrid network material.

Wen et al. does not, however, teach or suggest tailoring the concentration of a hydrophilic polymer constituent in a nanocomposite material to impart a predetermined water permeability to the nanocomposite material, as recited in independent claim 9.

As Polson et al., Novak et al., and Wen et al., when combined, do not teach or suggest each of the limitations of dependent claim 12, dependent claim 12 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al., Novak et al., and Wen et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claim 12 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” and Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach” as applied to claims 1-3, 5, 7, 9-12, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties”

Claims 13 through 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” and Wen et al., “Organic/Inorganic Hybrid Network Materials by the Sol-Gel Approach” as applied to claims 1-3, 5, 7, 9-12, 16-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Sebesta et al., “Composite Ion Exchanger with Ammonium Molybdophosphate and its Properties.” Applicants respectfully traverse this rejection, as hereinafter set forth.

Claims 13 through 15 depend from claim 9 and include the elements and limitations recited therein.

Applicants respectfully assert that claims 13 through 15 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the references relied upon by the Examiner because there is no motivation to combine the teachings of Novak et al. with the teachings of Polson et al., as discussed above in relation to claim 9.

Furthermore, there is no motivation to combine the teachings of Novak et al. with the teachings of Sebesta et al. Novak et al. does not describe, teach, or suggest that the simultaneous interpenetrating networks (SIPN's) described therein may be modified to include polyacrylonitrile, as suggested by the Examiner. As taught by Novak et al. in the third full paragraph thereof, “the key to designing SIPN systems is to select at least two noninterfering, efficient polymerization techniques.” Novak et al. does not teach or suggest what a noninterfering, efficient polymerization technique for an inorganic phase would be that could be used to form an SIPN with polyacrylonitrile as the organic phase. Furthermore, the polymers described by Novak et al. are cross-linked during formation of the interpenetrating networks described therein. *Novak et al.*, third full paragraph. There is no teaching or suggestion in either

Novak et al. or Sebesta et al. as to how one would go about cross-linking polyacrylonitrile. In sum, there is simply no teaching or suggestion in Novak et al. as to how an SIPN may be formed that includes polyacrylonitrile. At least for each of these reasons, one of ordinary skill in the art would not expect that interpenetrated networks described by Novak et al. could be successfully modified so as to include polyacrylonitrile (PAN), and would not be motivated to combine the teachings of Novak et al. with the teachings of Sebesta et al.

Additionally, the references relied upon by the Examiner, when combined, do not teach or suggest **“tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,”** as recited in independent claim 9.

As previously discussed herein, Polson et al. and Novak et al., when combined, do not teach or suggest **“tailoring the concentration of [a] hydrophilic polymer in [a] mixture to impart a predetermined water permeability to a nanocomposite material to be formed from the mixture,”** as recited in independent claim 9. The teachings of Wen et al. do not satisfy the deficiency.

Wen et al. summarize the then-current state of the art of organic/inorganic hybrid network materials formed by the sol-gel technique. Wen et al. teach that tetraethoxysilane may be used as an inorganic precursor for forming an organic/inorganic hybrid network material.

Wen et al. does not, however, teach or suggest tailoring the concentration of a hydrophilic polymer constituent in a nanocomposite material to impart a predetermined water permeability to the nanocomposite material, as recited in independent claim 9.

As Polson et al., Novak et al., and Wen et al., when combined, do not teach or suggest each of the limitations of dependent claims 13 and 15, dependent claims 13 and 15 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al., Novak et al., and Wen et al. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 13 and 15 under 35 U.S.C. § 103(a).

Obviousness Rejection Based on Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of U.S. Patent

No. 5,728,302 to Conner et al.

Claim 41 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Polson et al., “Synthesis, Characterization, and Ion Sequestration of Novel Nanocomposite Materials” in view of Novak et al., “Simultaneous Interpenetrating Networks of Inorganic Glasses and Organic Polymers” as applied to claims 1-3, 5, 7, 9-18, 20, 22, 31-34, 36, 38, 49, 52-53, 55, 57-58 above, and further in view of Conner et al. (U.S. Patent No. 5,728,302). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 41 depends from claim 32 and includes the elements and limitations recited therein.

Applicants respectfully assert that claim 41 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering the references relied upon by the Examiner because there is no motivation to combine the teachings of Novak et al. with the teachings of Polson et al., as discussed above in relation to claim 9

Applicants additionally assert that claim 41 could not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Polson et al. in view of Novak et al., and Conner et al. because the references relied upon by the Examiner, when combined, do not teach or suggest an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof, the interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough, as recited in independent claim 32, as currently amended.

As discussed above, Polson et al. and Conner et al., when combined, do not teach or suggest these limitations. The teachings of Novak et al. do not satisfy the deficiency.

Novak et al. teaches interpenetrating networks of inorganic glasses and organic polymers. Novak et al. does not teach or suggest, however, an *interpenetrating network* formed by an oxide constituent and a polymer constituent selected from the group consisting of polyacrylonitrile, polyethyleneoxide, polyethylene glycol, polyvinyl acetate, polyvinyl alcohol, and combinations thereof. Furthermore, Novak et al. do not teach or suggest an interpenetrating network having a metal ion sequestration constituent substantially uniformly distributed therethrough.

For each of the reasons set forth above, Applicants respectfully assert that dependent claim 41 could not have been obvious to a person of ordinary skill in the art at the time the

invention was made considering Polson et al. in view of Novak et al. and Conner et al., and request that the Examiner withdraw the rejection of dependent claim 41 under 35 U.S.C. § 103(a).

CONCLUSION

Claims 1-3, 5, 6, 8-18, 20, 21, 23-34, 36, 37, 39-53, and 55-59 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,

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